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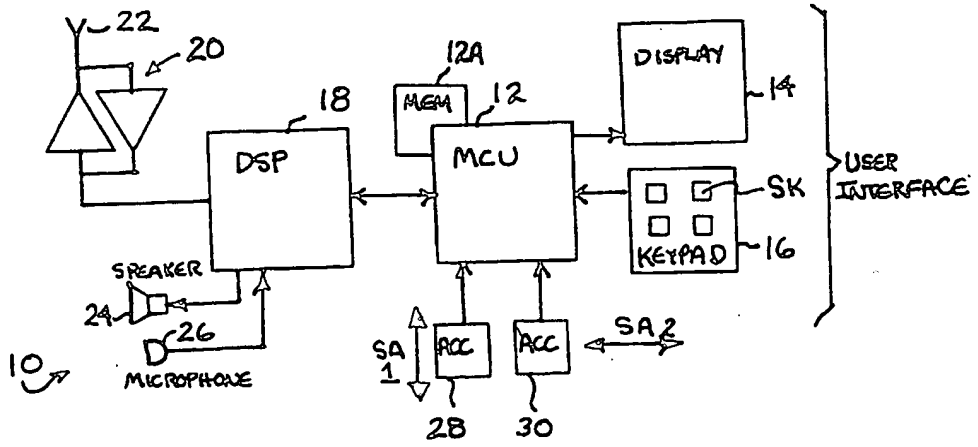
(54) Title: ACCELEROMETER AND SELECTION KEY(S) USED AS INPUT DEVICES FOR MOBILE RADIOTELEPHONE



(57) Abstract: A mobile communication terminal (MCT) is constructed so as to contain a data processor and a user interface coupled to the data processor. The user interface includes a visual display sub-system and a manual display control sub-system, wherein the manual display control sub-system includes at least one device for sensing a rotation of the MCT about a predetermined axis. In a presently preferred embodiment that at least one device is an accelerometer having a sensitive axix (SA) about which the accelerometer is capable of sensing accelerations. The accelerometer for changing at least an appearance of information that is displayed by the visual display subsystem in response to the sensed rotation. The accelerometer also for scrolling through displayed information in a direction and at a speed that is a function of the sensed rotation.

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ACCELEROMETER AND SELECTION KEY(S) USED AS INPUT DEVICES FOR MOBILE RADIOTELEPHONE

FIELD OF THE INVENTION:

This invention relates generally to mobile communication terminals, such as hand-held radiotelephones including cellular telephones and personal communicators, and more particularly is related to user interface methods and apparatus for mobile communication terminals.

BACKGROUND OF THE INVENTION:

The user interface of a mobile communication terminal (MCT) is an important aspect of the device. The user interface enables an operator of the MCT to make and receive calls, as well as to access, store, read out and modify information that is stored in the MCT. For example, the MCT may store a plurality of predefined menus that give the operator an ability to access the various applications that the MCT is capable of executing (e.g., a short message service (SMS) application) . The MCT may also store a phone book containing telephone numbers and names, as well as other contact information for parties called by the user. It can thus be appreciated that it is desirable to facilitate the ability of the user to interact with the MCT.

In many conventional MCTs there are provided a plurality of keys or buttons that are manually activated by the user in

order to interact with the MCT. For example, there may be one or more keys that when depressed enable the user to scroll through a menu list or a phone book list. Another key may then be activated to select a particular menu item or phone book entry. Still further keys may be provided for entering alphanumeric and other characters.

While these procedures may be more than adequate for many uses of the MCT, in some use environments it may be desirable to provide a different and even simpler technique to enter information and to access the stored functions and information of the MCT.

OBJECTS AND ADVANTAGES OF THE INVENTION:

It is a first object and advantage of this invention to provide an enhanced user interface for a MCT that enables a user to enter information and to access stored functions and information by changing an orientation of the MCT in three dimensional space.

It is a further object and advantage of this invention to provide a MCT that incorporates at least one accelerometer or equivalent device that is responsive to a change in an orientation of the MCT in three dimensional space to provide an input to a user interface.

It is another object and advantage of this invention to provide a MCT that incorporates at least one accelerometer or equivalent device that is responsive to a change in an orientation of the MCT in three dimensional space to cause the MCT to execute a scrolling operation.

It is a further object and advantage of this invention to provide a MCT that incorporates at least one accelerometer or equivalent device that is responsive to a change in an

orientation of the MCT in three dimensional space to cause the MCT to input alphanumeric and other characters.

SUMMARY OF THE INVENTION

The foregoing and other problems are overcome and the objects of the invention are realized by methods and apparatus in accordance with embodiments of this invention.

A mobile communication terminal (MCT) is constructed so as to contain a data processor and a user interface coupled to the data processor. The user interface includes a visual display sub-system and a manual display control sub-system, wherein the manual display control sub-system includes at least one device for sensing a rotation of the MCT about a predetermined axis. In a presently preferred embodiment that at least one device is an accelerometer having a sensitive axis (SA) about which the accelerometer is capable of sensing accelerations. In the preferred implementation these accelerations are due to the force of gravity. The data processor is responsive to an output of the accelerometer for changing at least an appearance of information that is displayed by the visual display subsystem in response to the sensed rotation.

For example, the data processor is responsive to the output of the accelerometer for scrolling through displayed information in a direction and at a speed that is a function of the sensed rotation.

The user interface may further include at least one manually operated switch, and the data processor is responsive to an output of the switch for terminating the changing of the appearance of the displayed information.

In another embodiment the data processor is responsive to

the output of the accelerometer for moving a cursor through displayed items of information in a direction and at a speed that is a function of the sensed rotation, and for then selecting an item of information corresponding to a current location of the cursor upon detecting the output of the switch.

In accordance with an exemplary method of this invention, there is provided a process for operating a MCT by the steps of (a) establishing a bidirectional wireless communication link with a global data communication network; (b) downloading at least one page of information and displaying the at least one page of information to a user on a visual display; (c) rotating the MCT about a predetermined axis; (d) sensing the rotation; (e) scrolling through the same page or through successive pages of information in a direction and at a speed that is a function of the sensed rotation; and (f) terminating the step of scrolling upon sensing an input signal generated by the user.

BRIEF DESCRIPTION OF THE DRAWINGS

The above set forth and other features of the invention are made more apparent in the ensuing Detailed Description of the Invention when read in conjunction with the attached Drawings, wherein:

Fig. 1 is a simplified block diagram of a MCT that incorporates at least one accelerometer in accordance with an aspect of this invention;

Fig. 2 is a top view of the MCT of Fig. 1, and shows an orientation of first and second accelerometer sensitive axes;

Figs. 3A, 3B and 3C are a side view of the MCT of Fig. 2 and depict the MCT aligned along a first neutral plane (Fig. 3A), rotated in a positive direction about the first sensitive axis out of the first neutral plane (Fig. 3B), and rotated in a negative direction about the first sensitive axis out of the first neutral plane (Fig. 3C); and

Fig. 4 is an end view of the MCT of Fig. 2 and depicts the MCT rotated in a positive direction about the second sensitive axis out of a second neutral plane.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 is a simplified block diagram of a MCT 10 that incorporates at least one accelerometer 28 in accordance with an aspect of this invention. The MCT 10 contains a data processor such as a microprocessor control unit (MCU) 12 that coupled to a visual display 14, such as an LCD, and that receives input from a keypad 16. The keypad 16 is assumed to include at least one Select Key (SK), as will be described in greater detail below. Other keys can include alphanumeric keys, soft keys, a power on/off key, etc., as is conventional in these types of devices. The combination of the MCU 12, display 14 and keypad 16 provides the user interface (UI) of the MCT 10. A memory (MEM) 12A stores an operating program for the MCU 12, as well as user entered and other data and constants. By example, the memory 12A may store Phonebook data representing a plurality of names and telephone numbers that were previously entered by the user.

The MCT 10 may also include a digital signal processor (DSP) type of device 18 that implements the required baseband and audio functions. A radio frequency (RF) transceiver 20 is bidirectionally coupled to the DSP 18, as

well as to at least one antenna 22. Using the transceiver 20 and antenna 22 the MCT 10 is enabled to establish bidirectional communication links with remote transceivers, and to gain access to voice and data communication networks. A speaker 24 (or earphone) and a microphone 26 are typically also coupled to the DSP 18 for enabling a user to make and receive telephone voice calls.

In accordance with the teachings of this invention the MCT 10 also includes at least one accelerometer (ACC) 28 having a sensitive axis (SA1) about which the accelerometer is capable of sensing accelerations. In the preferred implementation these accelerations are due to the force of gravity. As will be described below, a second accelerometer 30 may also be provided so as to have its sensitive axis (SA2) aligned differently (e.g., orthogonally) to the sensitive axis (SA1) of the first accelerometer 28. In this manner the MCT 10 is capable of sensing accelerations about each sensitive axis.

Fig. 2 is a top view of the MCT 10, and shows an exemplary orientation of both of the sensitive axes, as well as the viewing directions of Figs. 3 and 4.

Figs. 3A, 3B and 3C are a side view of the MCT 10 of Fig. 2 and depict, in Fig. 3A, the MCT 10 aligned along a first neutral plane (NP1), rotated in a positive direction about the first sensitive axis out of the first neutral plane (Fig. 3B), and rotated in a negative direction about the first sensitive axis out of the first neutral plane (Fig. 3C). Fig. 4 is an end view of the MCT 10 and depicts the MCT 10 rotated in a positive direction about the second sensitive axis out of a second neutral plane (NP2).

The first neutral plane NP1 is defined such that the first accelerometer 28 does not experience an acceleration due to

gravity, and thus ideally provides either no output to the MCU 12 or an output indicating zero acceleration. In practice, the first neutral plane (and hence the orientation of the first accelerometer within the case of the MCT 10) is such that the MCT 10 is positioned in some convenient orientation relative to the local normal. For example, and assuming that the MCT 10 is designed to be held in the hand during use, the first neutral plane may be oriented at 45 degrees to the local normal (LN). When the MCT 10 is subsequently rotated about the first sensitive axis (SA1) in either a positive or a negative direction, and hence is rotated either in to or out of the first neutral plane, the accelerometer 28 detects the acceleration due to force of gravity and generates an output. The magnitude of this rotation, indicated by the angle (A) in Figs. 3B and 3C, generates a proportionate increase or decrease in the output signal of the accelerometer 28, while the direction of the rotation can be indicated in the sign of the output signal. Alternatively, when located in the neutral plane the output of the accelerometer 28 may have some value X, and subsequent rotations in to or out of the neutral plane can cause a corresponding increase or decrease in the value of X.

The same holds true for the rotation shown in Fig. 4, wherein the magnitude of the rotation (indicated by the angle B) about the second sensitive axis (SA2) in to or out of a second neutral plane (NP2) results in a proportionate output signal from the second accelerometer 30.

Further in accordance with the teachings of this invention, the MCU 12 of Fig. 1 interprets the output of the accelerometer 28 (and accelerometer 30 if provided) as an input user interface signal and employs same to control the direction of the scrolling of information on the display

14. In a preferred, but not limiting embodiment the speed of the scrolling is controlled as well. This scrolling can be used to display in succession the names of various applications such as: "Phonebook", followed by "Messages", followed by "Settings", followed by "Security Options", etc. As the magnitude of the angle A is made greater (in a positive or a negative sense), the scrolling speed may be caused to increase in a proportionate manner.

While scrolling, and if the Select Key (SK) is depressed, the MCU 12 interprets this signal so as to terminate the scrolling operation, regardless of the current orientation the MCT 10. That is, the output signal of the accelerometer 28 can be simply ignored, or the accelerometer 28 may be de-energized to save power. If the Select Key is released, then the scrolling operation can be restarted.

While described above in the context of scrolling to a desired application (e.g., Phonebook), after having selected the Phonebook application the scrolling feature may be again used to scroll through the stored list of names and telephone numbers until a desired entry is found. Depressing the Select Key again can then interpreted as a signal that indicates that the currently displayed Phonebook entry is to be selected, such as by automatically originating a call to the telephone number stored for the currently displayed Phonebook entry. Thus, the teachings of this invention can be used to scroll both to and then through a desired MCT 10 application.

In other embodiments the use of this invention can be used when scrolling through other types of displayed information. For example, assume that the MCT 10 has been used to log on to a global data communications network, such as the Internet. The use of the accelerometer 28 can then be employed by the user to scroll through displayed

World Wide Web (WWW) pages, to stop at a desired page, and to then scroll through the displayed desired page.

The second (optional) accelerometer 30 may be employed in a different manner for moving an indicator, such as a cursor 14A (see Fig. 2), in a left to right or right to left fashion across a row of displayed alphanumeric characters (e.g., "AaBaCaDa..."). For example, the orientation shown in Fig. 4 may be one where the cursor 14A moves in a left to right fashion at a speed that is a function of the magnitude of the angle B. When reaching the end of a current row the cursor 14A may wrap to the next row. When the cursor 14A is positioned over a desired character, depressing the Select Key may be interpreted as a signal to select the indicated character, thereby entering the character into an underlying application (e.g., a Message Composition application or the Phonebook application) in the same manner as a character would be entered by depressing a corresponding key on the keypad 16. When used in this type of alphanumeric character entry mode the output of the first accelerometer 28 may be employed to move the cursor 14A from row to row. In this manner a simple manipulation of the MCT 10 in three dimensional space is sufficient to navigate the cursor 14A around the display 14.

It should be noted that the Select Key (SK) need not be a separate and dedicated keypad key, but could be an already existing key (e.g., a soft key) whose function is redefined when operating the accelerometer 28 (and/or 30).

Those skilled in the art should realize that the teachings of this invention enable a simplified and uncluttered user interface to be provided, wherein a required number of scrolling arrow keys and the like can be reduced or eliminated.

It should be further realized that the MCT 10 may also include conventional keypad keys and functionality for scrolling through displayed information and for entering information in a conventional manner, for use during those times when the user may not desire to use the accelerometer 28 (and/or 30).

It should also be appreciated that the angle of the first neutral plane (NP1) with respect to the local normal (LN) need not be fixed. That is, it is within the scope of these teachings to provide a MCT 10 calibration application and procedure whereby, and by example, the user selects and enters the calibration application, orients the MCT 10 at some desired angle about the first sensitive axis SA1 (or the second sensitive axis SA2), and then depresses SK or some other key to signal the MCU 12. In response, the MCU 12 reads the current output of the associated accelerometer 28 or 30, and then stores this value in the memory 12A as a "zero" value that is indicative of the angular relationship between the desired neutral plane and the local normal. Subsequent rotations of the MCT 10 are then referenced to this zero value.

While described in the context of the use of the accelerometers 28 and 30 for sensing rotations of the MCT 10, as well as the orientation of the MCT 10 in three dimensional space, the teachings of this invention are not limited to only the use of accelerometers. In general, any device or devices that are capable of detecting a motion or a rotation of the MCT 10 relative to some reference axis or plane may be employed.

Furthermore, the MCU 12 may be used to de-energize one or both of the accelerometers 28 and 30 when their use is not required, thereby reducing power consumption. For example, when scrolling through an application or a data file using

the accelerometer 28, the accelerometer 30 may be de-energized or otherwise placed in a reduced power consumption state. If an application is then selected that requires character input, the accelerometer 28 can be de-energized, or otherwise placed in a reduced power consumption state, and the accelerometer 30 energized.

Thus, while the invention has been particularly shown and described with respect to preferred embodiments thereof, it will be understood by those skilled in the art that changes in form and details may be made therein without departing from the scope and spirit of the invention.

CLAIMS

What is claimed is:

1. A method for operating a user interface of a mobile communication terminal (MCT), comprising steps of;

rotating the MCT about a predetermined axis;

sensing the rotation; and

changing an operator's visual display in response to the sensed rotation.

2. A method for operating a user interface of a mobile communication terminal (MCT), comprising steps of;

rotating the MCT about a predetermined axis;

sensing a direction and a magnitude of the rotation; and

changing an operator's visual display in response to the sensed direction and magnitude of rotation.

3. A method for operating a user interface of a mobile communication terminal (MCT), comprising steps of;

rotating the MCT about a predetermined axis;

sensing the rotation;

scrolling through displayed information in a direction and at a speed that is a function of the sensed rotation; and

terminating the step of scrolling upon sensing an input signal generated by a user.

4. A method for operating a user interface of a mobile communication terminal (MCT), comprising steps of;

rotating the MCT about a predetermined axis;

sensing the rotation; and

operating a visual display to move a cursor in a direction that is a function of the sensed rotation.

5. A method for operating a user interface of a mobile communication terminal (MCT), comprising steps of;

rotating the MCT about a predetermined axis;

sensing the rotation;

operating a visual display to move a cursor through displayed items of information in a direction and at a speed that is a function of the sensed rotation; and

selecting an item of information corresponding to a current location of the cursor upon sensing an input signal generated by a user.

6. A mobile communication terminal (MCT), comprising:

a data processor; and

a user interface coupled to said data processor, said user interface comprising a visual display sub-system and a manual display control sub-system, wherein said manual display control subsystem is comprised of at

least one device for sensing a rotation of said MCT about a predetermined axis, and wherein said data processor is responsive to an output of said at least one device for changing at least an appearance of information that is displayed by said visual display subsystem in response to the sensed rotation.

7. The MCT of claim 6, wherein said data processor is responsive to said output of said at least one device for scrolling through displayed information in a direction and at a speed that is a function of the sensed rotation.

8. The MCT of claim 6, wherein said user interface is further comprised of at least one manually operated switch, and wherein said data processor is responsive to an output of said switch for terminating the changing of the appearance of the displayed information.

9. The MCT of claim 6, wherein said data processor is responsive to said output of said at least one device for moving a cursor through displayed items of information in a direction and at a speed that is a function of the sensed rotation.

10. The MCT of claim 9, wherein said user interface is further comprised of at least one manually operated switch, and wherein said data processor is responsive to an output of said switch for selecting an item of information corresponding to a current location of said cursor.

11. The MCT of claim 6, wherein said data processor is responsive to an input from a user for calibrating a neutral plane for said at least one device, and for storing data in a memory that is indicative of said neutral plane.

12. The MCT of claim 6, wherein said data processor is

operable for placing said device in a reduced power consumption mode of operation.

13. A method for operating a mobile communication terminal (MCT), comprising steps of;

establishing a bidirectional wireless communication link with a global data communication network;

downloading at least one page of information and displaying the at least one page of information to a user on a visual display;

rotating the MCT about a predetermined axis;

sensing the rotation;

scrolling through the same page or through successive pages of information in a direction and at a speed that is a function of the sensed rotation; and

terminating the step of scrolling upon sensing an input signal generated by the user.

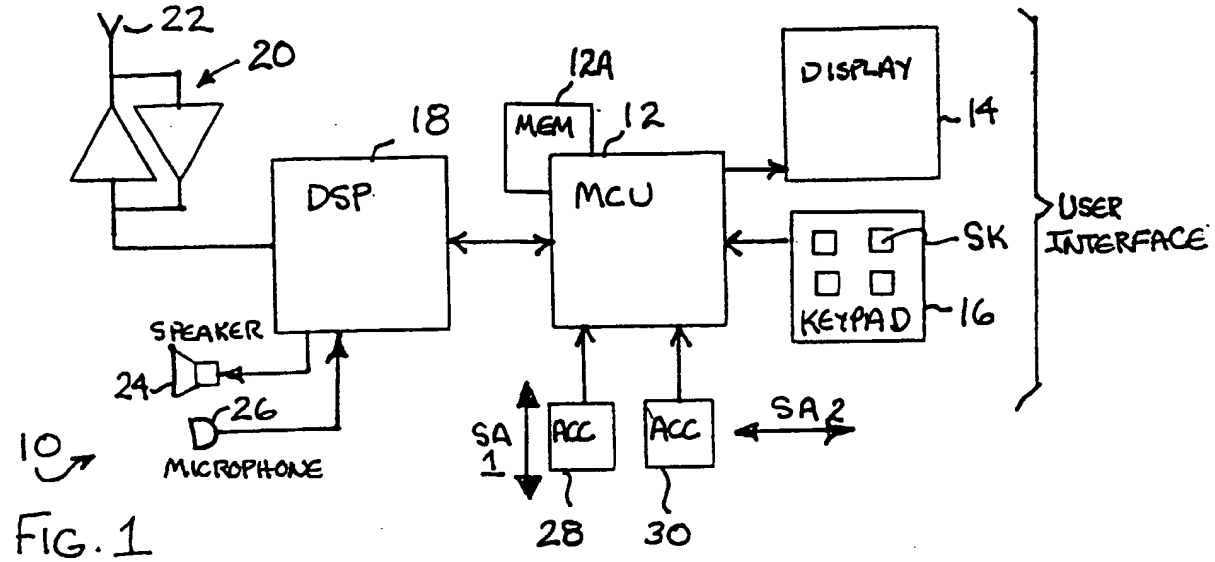

FIG. 1

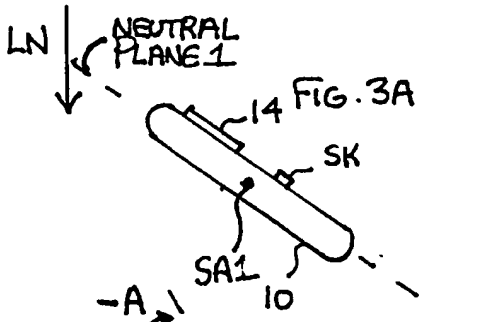

FIG. 3A

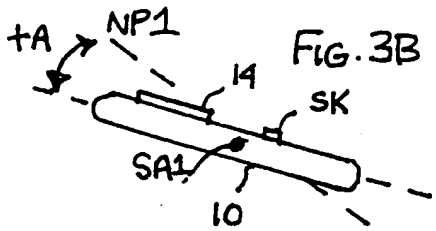

FIG. 3B

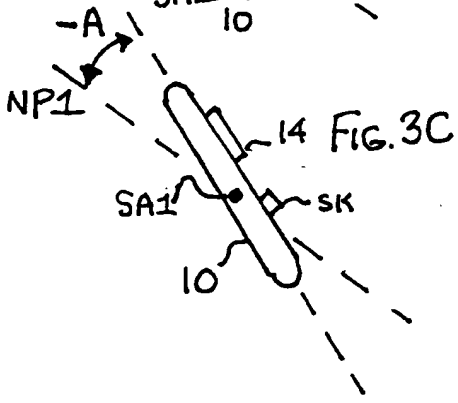

FIG. 3C

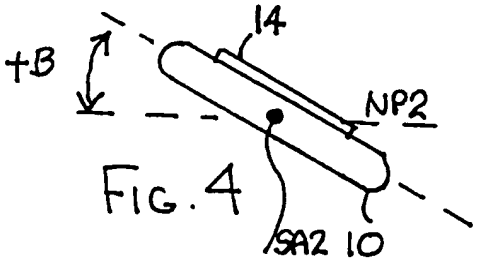

FIG. 4

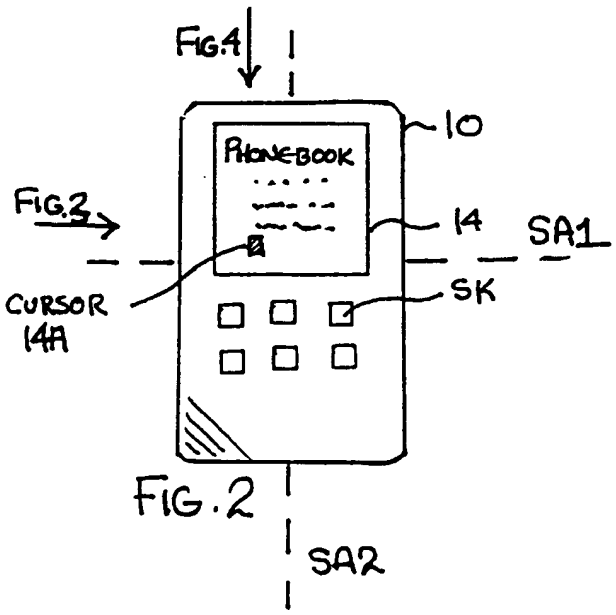

FIG. 2